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Abstract

In this paper the relation between container terminal services and quality is explored. Quality elements that are important to terminal customers are reliability, flexibility, availability, time, costs, control, and after sales support. Overall, it is important for the terminal operator to provide services that deliver excellent quality and fit into the value chain of its customers. From past and current research it follows that especially reliability and costs (related to quality) are important quality dimensions for the overall quality. Theory shows that structural measurement of quality is possible and this also holds for quality of container terminal services. If measurement takes place, knowledge of the quality performance is the result. Probably, this knowledge about the quality performance results in a need for improvement. This improvement of terminal quality may result in a better price for the services provided. At this moment, it is not possible to compare terminal service quality on this regular bases, as no data are available.

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1 Introduction

In the very competitive container terminal handling market, quality is important in attracting and retaining customers. Container carriers do have choices between different container ports that can meet their demand. This results in the increasing importance of quality and the need to know the needs of customers. A favourable network position and well-organised processes are no longer sufficient. Meeting the customer needs and delivering prime quality are critical factors nowadays. In their supply chain, container carriers are interested in speed and reliability. The time a ship stays in a port must be minimised, and, therefore, the handling of containers must be executed in a fast and reliable way. Minimising the number of containers that is damaged or lost forms another part of the quality picture. The operations at the terminal, after the handling of the containers on and off the ship, must be reliable as well. Quantitative information on container terminal quality is not available. In general, there are very few container terminals that are monitoring their quality levels. In general, higher quality levels justify higher prices and this brings us to the problem description of this paper:

***Is** it possible to measure quality of container handling services?*

This question is explored here by comparing the container handling sector with other sectors and competitors (see also Wiegmans et al., 1999). Unfortunately, there are almost no data available on terminal quality, so that a literature survey forms the main input for the present paper. The aim of this paper is to offer an approach for the measurement of quality of container terminal services. For this purpose, the well-known SERVQUAL-model is used here in order to present a new and operational view on the judgement of service quality of container terminals by terminal customers (Parasuraman et al., 1991). Section 2 gives an overview of the history of quality and definition of services. In section 3, the SERVQUAL model will be applied to the container terminal market. Section 4 analyses the success factors that are critical and identifies which factors are necessary in relation to prices. Section 5 concludes on the problem.

2 Theory of quality of services

Definition of service

According to Kotler (1997) a service is any activity or benefit that one party can offer to another that is essentially intangible and does not result in the ownership of anything. Generally, a service can be characterised by the following four distinguishing marks:

1. Intangible;
2. Simultaneous production and consumption;
3. Heterogeneity;

4. Transitory.

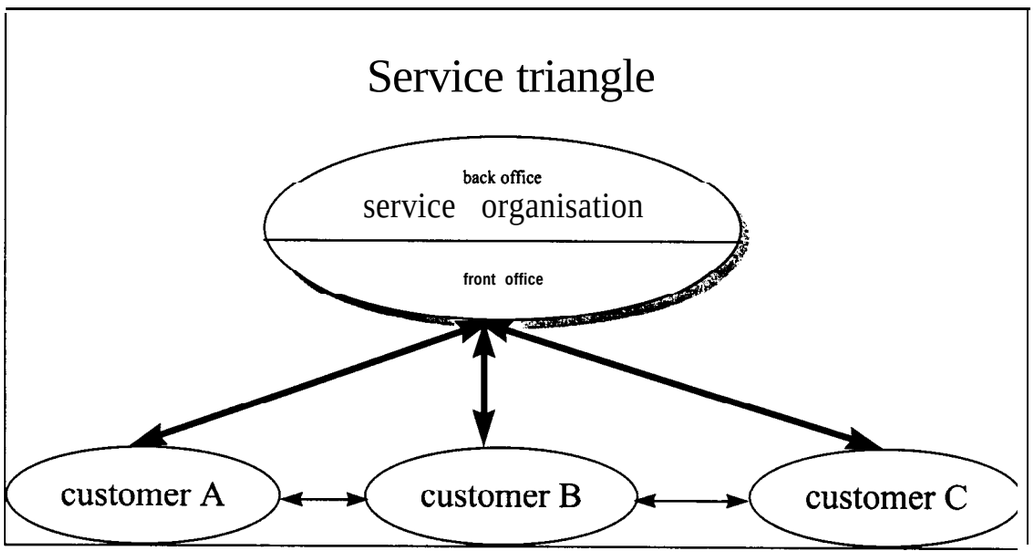
Intangible means that "a service can not fall on your feet". Generally, a service is not physical but it is more a sort of experience, which means that material possessions do not increase if a service is bought. Intangibility is to be seen as a criterion that varies between 0% and 100%. A pure service is 100% intangible, while a pure good is 0% intangible or tangible. Simultaneous production and consumption is also referred to as interactive consumption, the consumer needs to be present when the service is produced. In this context, the consumer is more regarded as *aprosumer*. The customer is then partly seen as producer of the service. A clear example of being a prosumer is an interactive container tracking- and tracing system. The consumer is asked, via the Internet, to provide specific information about his shipment to the transport carrier. After sending the required information to the transport carrier, the status of his shipment is provided. The container terminal service is special in the fact that the service is bought by the management of a container carrier, but the service is 'experienced' by employees who operate the ships. Because of the participation of the customer in the service production process, it is difficult to standardise services. The customer influences the quality of the service. Requiring the presence of customers by the production of the service implies that the factor time increases in importance. Time may be split into objective time (time in minutes/hours/days) and subjective time (perceived time by the customer). The transitory character of services means that the creation of stocks is impossible. This results in an increased importance for capacity management. Management of supply and demand for services ideally results in minima1 unused capacity. This applies to both quiet and busy periods (for example, ship congestion when all berths are occupied or terminal congestion arises).

Service production process

In the service process usually the front office of a service organisation interacts directly with customers. This direct interaction is often conceded as 'the moment of truth' for the service organisation. The back office is usually not visible for customers. It may be of strategic importance for the service organisation to manipulate the size of its front and/or back office. The conventional service triangle consists of three actors (De Vries et al., 1994):

1. The service organisation (back-office)
2. Its contact personnel (front-office)
3. Its customers.

Figure 1 Conventional service triangle



Source: based on De Vries et al., 1994

The production process of a service can be based on a customer orientation, a competitor orientation or a market orientation. In a customer orientation, the main objective of the producer of the service may be to fulfil a customer need. He can strive to provide a better price/quality service than his competitor in a competitor orientation or he can provide his service customer and competitor oriented (market oriented). A relatively new orientation is process oriented. In this case the service is seen as part of the whole supply chain and there is an extensive exchange of information between actors in the supply chain in order to be able to perform all services in a smooth manner. If we then zoom in on the relation between the terminal operator and its customers we actually see that there are four actors engaged in the service process. There is the terminal operator, his personnel, the terminal customer, and the terminal customer personnel. Thus, instead of the three usual actors in the service process, at the container terminal there is one extra actor engaged in the process (See Figure 1). Thus, actually we have two service production processes: one for the terminal customer and one for the terminal customer's personnel.

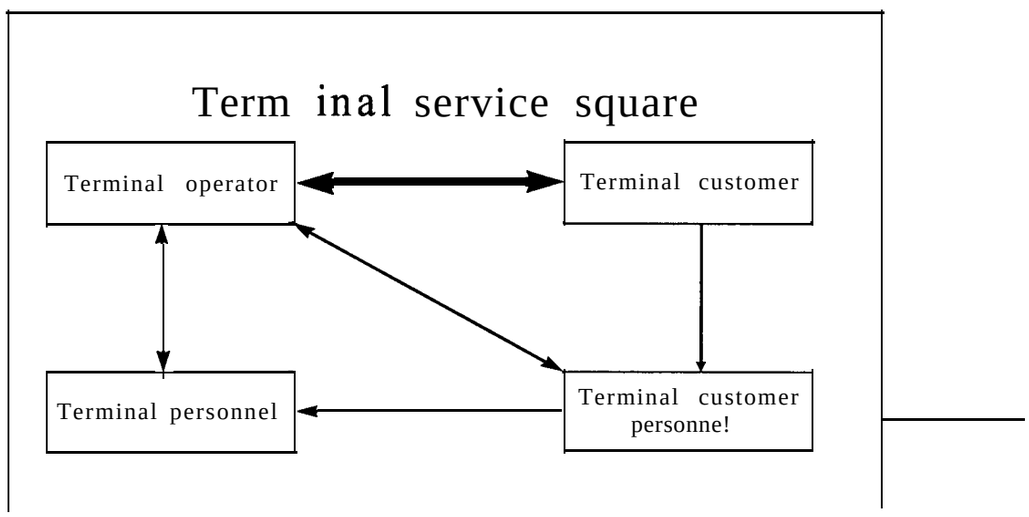


Figure 2 Terminal service square and actors involved

Source: based on De Vries et al., 1994

History and background of quality analysis

According to Garvin (1984) four phases in the development of quality can be distinguished: 1) inspection; 11) statistic quality control; 111) integrated quality care; IV) strategic quality management. The approach to quality used in this paper is embedded in marketing research. The user (customer) of terminal services fixes the service quality. Generally, in this approach service quality is defined as "the difference between expectation and observation". Research from Parasuraman, Zeithaml, and Berry (1988) show five dimensions on which users, in general, judge quality. These five dimensions are:

1) tangible matters (e.g. facilities or personnel)
2) reliability (e.g. ability to perform a service reliable and accurate)
3) responsiveness (e.g. willing to help customers and to perform a service quick)
4) assurance (e.g. knowledge and courteous personnel)
5) empathy (e.g. care for the individual customer).

Grönroos (1990) identified two dimensions of quality: technical quality and functional quality. Technical quality has to do with what service is produced, functional quality has to do with how is the service produced? Total Quality Control according to de Vries et al. (1994) is: "a targeted system to integrate the stiving of all groups within an organisation for developing, maintenance, and improvement of quality, in order to organise service and production as efficient as possible, leading to a complete satisfied customer". In general, the perception of marine terminal services and the actual terminal service performance is not high resulting in dissatisfíed customers. Reason enough for an increasing number of container carriers to start operating their own container terminals. A complicating factor for the terminal operator in this respect is the wide variety of terminal customers. Almost each terminal customer needs its' own terminal service quality performance. Current transport research in the EU (IQ, 1997, TERMINET, 1998) shows the following important quality elements concerning transport: time, reliability, flexibility, qualification, accessibility, control, costs, frequency, speed, long term planning, management, and safety and security. Reliability refers to the leve1 of (time) certainty with which the service is performed.

3 Container terminal quality and the SERVQUAL model

Container terminal services

At a container terminal the single most important activity is the movement of containers, whereas the secondary function is storage. This primary function of a container terminal can be divided into different parts: loading, unloading, and direct transshipment of containers. Transshipment is the unloading of a Transport Unit (TU) directly followed by the loading of the TU onto another transport means. Handling is the unloading of a TU followed by the temporary storage of the TU at the terminal, which is followed in the end by loading the TU on another transport means for further transport. The activities performed at the container terminal are focussed on the handling ([un]loading and transshipping) of containerised cargo. At a container terminal we may find the following activities:

A. *Ship oriented services;* discharging the ship, loading the ship, direct transhipment, storage of container/warehousing, and container groupage

B. *Yard orien ted services;*

C. Other terminal services; manufacturing, renting/leasing/selling services, collection/distribution of container, physical transport of container, container monitoring, and other services. Bowersox et al. (1986) view handling as one of the most costly aspects of logistic Channel performance, and thus the objective is to reduce handling operations in the logistic chain to an absolute minimum. This creates an extra dimension concerning quality; there is a tendency to minimise terminal handling to a minimum, stressing the importance of quality even more.

Ship oriented services consist of the discharging of ships, loading of ships, restowing ships and ancillary charges. These services are further specified according to full or empty containers, '20, '40 or over dimensional containers, stowage containers, transshipment containers and special handlings. Other distinguishing features are restowing onto the same or a different area aboard the ship, and restow after the container has been discharged and reloaded. Other elements are lashing and unlashing containers, hatch covers, and uncontainerised cargo handling. Yard operations consist of the handling of full and empty containers and import and export storage. These services are further specified according to '20 and '40 containers, rehandling containers, road/rail container handlings, containers that missed a ship and must wait for the subsequent vessel, containers that change status, container extemal wash, containers intemal cleaning. The distinction between services is necessary in order to be able to determine which services are important or should be important to the terminal operator. In addition to this, performance measures should be developed to be able to monitor the performance of the terminal on the chosen quality aspects.

Actors in the service process and quality

Besides the services provided, the actors and especially the customers are important because they must judge the quality of the services offered. A major complicating factor in the container terminal market is found in the numerous different actors that are active in this market. If we focus on terminal customers, we may distinguish between four main groups of customers:

1. Container carriers (deep-sea shipping companies);
2. Transport companies (rail-, road-, barge-, and short-sea transport companies);
3. Importers/exporters (intermediaries such as stevedore, ship broker, shipping agent and forwarder);
4. Shippers (companies that sent and receive the freight).

The terminal handling service buying process can be divided into three activities:

1. pre-purchase phase (problem detïnition, information collection, and evaluation of altematives);
2. consumption of the terminal service;
3. post-purchase phase (evaluation of the terminal services).

In the pre-purchase phase the actors are the terminal operator and the terminal customer. Usually, the terminal customer personnel, the terminal personnel and the terminal operator consume the terminal service. The terminal customer and his personnel execute the evaluation of the service. Generally, the customers do not have a presence duty. The service presented to the terminal customers is quite homogeneous and there is no need for participation of the terminal customer in the service production process. Furthermore, the customer service is intangible, there is no need for simultaneous production and consumption, and the objective terminal transit time is highly important.

Market segments and container terminal services

The main customer groups must be identified in order to be able to determine the weight that must be placed on the judgements of the different groups. The services that are provided can be grouped according to type of customers, importance of different sales categories, type of container (process) or to transport mode (network). Usually, terminal operators are not entirely clear about their customers, and therefore offer a broad package of tünctions for the sake of risk-spreading and widening the operating base (many potential customers). In the continental terminal market much is expected from new generation terminals (Bontekoning and Kreutzberger, 2001). These types of terminals are expected to deliver an improvement of the tost-quality ratio of terminal operations (Konings and Kreutzberger, 2001).

Costs of service quality

A useful concept in analysing the cost of terminal service quality may be that of value density (value per unit weight). The value density reflects the relative importance of container in transit and inventory in the logistical system (Magee et al., 1985). In any business, this suggests that it might be preferable to stock low-value items rather than high-value items. The terminal operator can also use this knowledge: the higher the value of the container the operator is transhipping the more important reliability and speed become. Generally, costs of service quality are comprised of (de Vries et al., 1994):

1. prevention costs (e.g. training programs)
2. inspection costs (e.g. costs of quality tests)
3. intemal repair costs (e.g. costs to repair errors before the product or service reaches the customer)
4. extemal repair costs (e.g. costs to repair errors after the product or service has reached the customer)
5. Lost sales do not induce direct costs but may well represent the highest damage to the company of delivering worse service quality.

Delivering good quality services only requires inspection costs and prevention costs, whereas worse service quality costs are also comprised of intemal and extemal repair costs, and of lost sales. The total handling service costs should always be placed in the perspective of the total supply chain costs. The terminal handling costs depend -besides the desired quality level- on container characteristics (value), size of shipment (volume), weight, handling difficulty, density, buying of additional terminal services, and transport distance at the terminal.

Terminal service quality

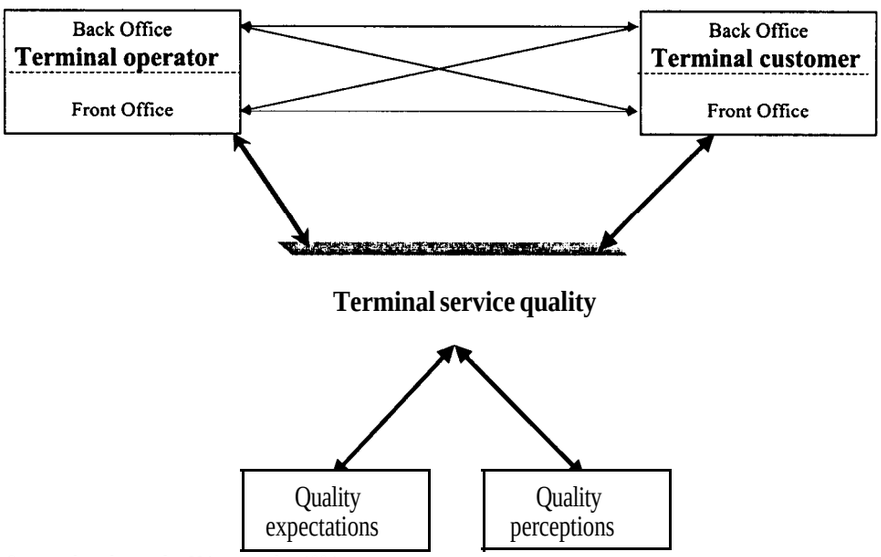
The measurement of service quality can, in general, be done on three aspects: search, experience, and credence attributes. Search attributes are quality features that can be identified by the customer before the purchase of a certain service. Experience attributes are features that can only be disclosed during or direct after the consumption of a certain service. Finally, credence attributes are features that can not be identified by customers, neither for nor after the consumption of the service. Salient Multi-Attribute Research Technique (SMART) is a well-known research technique to measure service quality (de Vries et al., 1994). SMART enables the identification of service elements that according to customers need the highest priority when improving the service. Another research technique is called conjunct research (de Vries et al., 1994). In this technique in depth interviews provide the service attributes with

the corresponding levels. Each attribute is connected with a number of service levels and each customer is asked to evaluate certain imaginary services.

Terminal customers and quality

In Figure 3 the main elements influencing and following from terminal service quality are depicted. The terminal customer provides the terminal operator with requirements conceming the desired terminal service. Especially flexibility requirements have been growing in importance during the past years (Kuipers, 1999). The terminal customer consists of two elements; the management (back office) and the employees (front office) that are present when the service is produced at the container terminal. The terminal operator also consists of two sub elements; front office and back office. This results in four groups that may have different expectations and observations about terminal service quality. This means that both the terminal customer's front- and back office must judge the quality of the terminal service. An extra complicating factor is that for the terminal operator the inclusion of the value chain approach in the quality delivery is extremely important, because it is the channel, not the terminal operator that delivers the products and services to the final customers. Without Channel co-ordination it may be even harder to realise an adequate terminal service performance level.

Figure 3 Terminal service quality environment



Source: based on de Vries et al., 1994

The SER VQUAL-model

The SERVQUAL-model of Parasuraman, Zeithaml, and Berry (1985) represents a useful instrument to structure quality research. In this model the difference between customer

expectations and observations (valuations or judgements) is measured. Quality is defined here as:

Observation (0) - Expectation (E) = Quality (Q)

If the expectation of the customer is greater than his observation there is a lack of quality. Quality is delivered when the observation is equal to the expectation. More quality is delivered if the observation of the customer is greater than his expectation.

Container terminals and quality aspects

The objectives of terminal operators may be stated as cost minimisation/profit maximisation, capacity oriented and realising politica1 goals (e.g. environment, enhancement of status and role). Given those mixed approaches towards terminal operations, the importance on terminal quality measurement and improvement is even higher. The terminal operators may accomplish especially the increase in terminal service performance and must then define 'target' quality levels. The terminal operator should translate quality requirements of customers into performance statements. Current transport research in the Eu (IQ, 1997, TERMINET, 1998) shows the following important quality elements: time, reliability, flexibility, qualification, accessibility, control, costs, frequency, speed, long term planning, management, and safety and security (see also section 2). Other quality elements could be credibility, communication, availability, the ability to provide timely and accurate information, after sales support, and the capability to respond to malfunctions in the logistics system. The set of quality elements in the table below is a combination of the SERVQUAL-model and the transport research in the EU.

Table 1 Quality aspects of container terminals

Accessibility	Ease to use the handling system (certain container types)
After sales support	Complaint handling by the terminal
Assurance	The knowledge and courtesy of the container terminal's employees and their ability to convey trust and confidence (credibility)
Availability	Able to be used
Control	Tracking and tracing facilities (to provide timely and accurate information about the status of the shipment)
Costs	Cost per TEU/FEU for handling
Empathy	The caring, individualised attention the terminal provides its customers
Flexibility	To respond to malfunctions in the logistics system (ability to provide special service requirements).
Frequency	Number of terminal handling services per time unit
Long term planning	Value chain orientation

Reliability	Refers to the level of (time) certainty with which the service is performed. (consistency of transit time)
Responsiveness	The willingness of the container terminal to help customers and provide prompt service
Safety and security	Risk of damage or loss of container in transit
Speed	Time needed for a terminal transhipment
Tangibles	The appearance of the container terminal% physical facilities, equipment, personnel, and communication materials
Time	Average terminal transit time (the longer the transit time, the higher the inventory levels and inventory carrying cost).

In the best case it is possible to ask customers on the importance of all quality aspects and their judgements (or their expectations on these items). In practice, in most cases time will be restricted and the most important quality aspects must be selected. The consequence of measurement is knowledge. Knowledge about customer's expectations and observations of the delivered container terminal service quality is the result.

4 Container terminal service quality and critical success factors

Quality judgement history

In general, container terminal services have no history conceming quality measurement. In the field of transport mode comparison and also in the field of logistics, some research has been carrier out on quality aspects. In the field of logistics it has been shown that in the past average delivery time was the most important customer service element in correlation with customer satisfaction. See also table 2. This table indicates the importance of different quality aspects to customers. It not applies to transport or logistics companies, but also to terminal operators.

Table 2 Customer service elements of logistics

Customer service elements	Correlation Coefficient*
average delivery time	0,76
delivery time availability	0,72
order status infotmation	0,67
rush service	0,59
order methods	0,56
action on complaints	0,56
accuracy in filling orders	0,46
returns policy	0,44
billing procedure	0,39

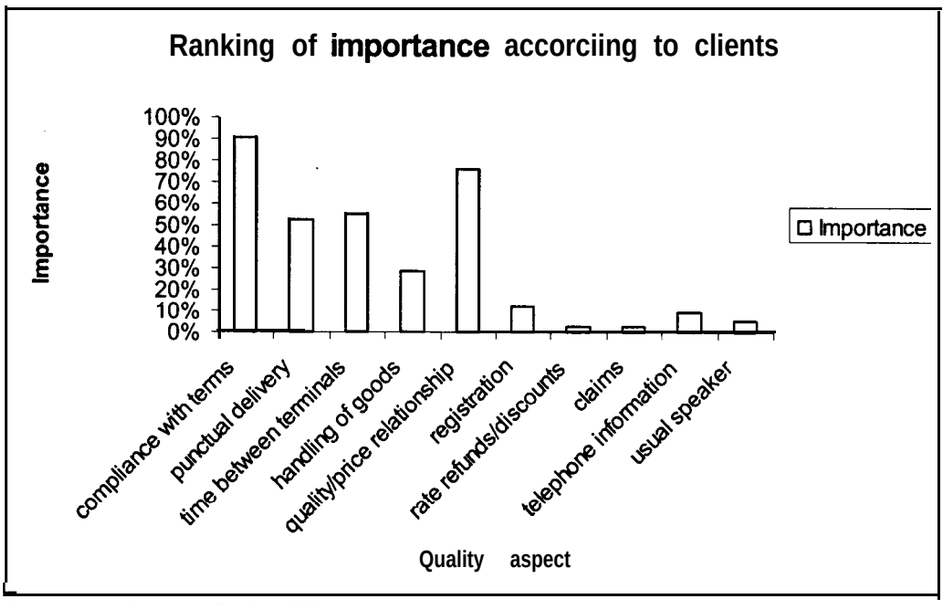
* Correlation between service element and customer satisfaction.

Source: Perreault and Russ, 1976

Quality judgement

In the annual report of RENFE (1998) there is also a short section on quality measurement concerning intermodal transport including the use of continental container terminals.

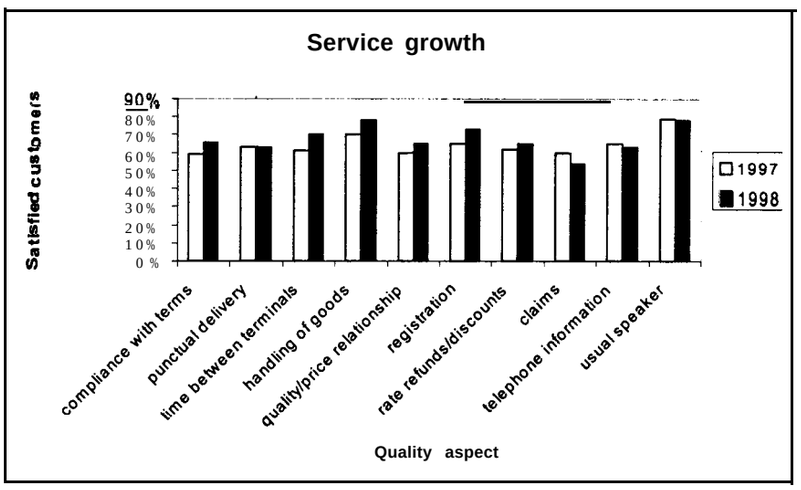
Figure 4 Quality aspects and customer judgement of rail service



Source: Annual report Renfe, 1998

This more recent quality judgement concerns rail services, including the use of container terminals. It shows that, according to clients, complience with terms and price/quality relationships are the most important quality aspects. Complience with terms may also be stated as reliability.

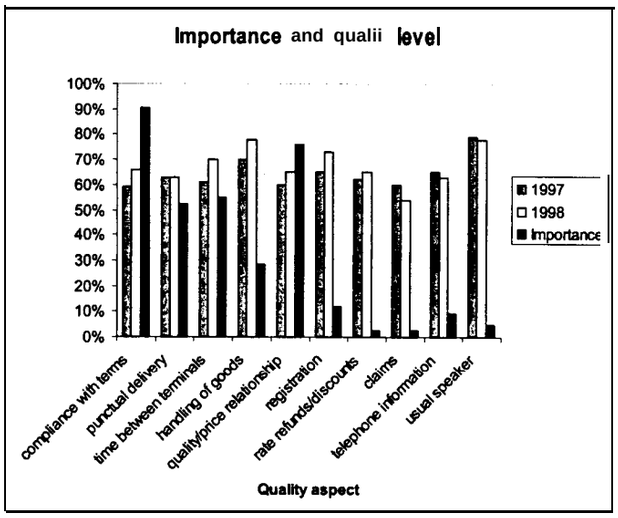
Figure 5 Development of judgements of quality characteristics of rail service



Source: Annual report Renfe, 1998

Figure 5 depicts the development of the quality judgement of the RENFE customers from 1997 to 1998. It shows that the number of satisfied customers needs more strengthening. In general, a well-performing service company may reach levels of 95% percent and more for satisfied customers.

Figure 6 Importance of quality characteristics and corresponding judgements



Source: Annual report Renfe, 1998

Figure 6 shows that the quality aspects that are the most important (compliance with terms and price/quality relationship) are also those where customers are least satisfied. Figure 5 and 6 provide insight into the expectations and importance of customers about performance and the actual performance.

Price setting and quality

Some terminal productivity measures may be helpful for the terminal operator to better quantify handling service benefits (improved quality) and costs. The benefits for the terminal operator are difficult to quantify because of the trade-off between costs and quality. This trade-off is dictated by three variables: service variability, the relative importance of handling costs as compared with total transport costs, and the nature of the value-added chain (Magee et al., 1985). For example, a broader terminal service package will require significant cost to obtain a high service level. Handling costs versus total transport costs reflects the viability of the different transport options. Finally, the value-added chain decides on the speed with which the different goods need to be handled by the terminal operator. In general, the demand for container transport is inelastic (Coyle, 1994). Thus, container rate reductions (e.g. terminal

service charges) will not dramatically increase the demand for container transportation. However, demand is price sensitive on a modal and specific carrier basis.

Time management

The terminal operator needs to pay special attention to the waiting time for the terminal customer's personnel. Generally, waiting time is connected with capacity management and ICT-technology. Furthermore, the terminal operator on three levels can influence the satisfaction with the waiting time:

- *Expectations* from the customers about the situation
- *Tolerance* of the customer to the waiting at the moment
- *Evaluation and valuation* of the waiting itself.

This so-called terminal congestion imposes a great threat to the efficient operation of especially marine container terminals. In Rotterdam, for example, the time between arrival of the maritime container and inland transport is judged to be too long by the terminal customers. This is partly due to veterinary control and the container scan (Nieuwsblad Transport, 2001). Container scan control time may add up to five days for rail transport. Road transport does not meet these problems; a scan takes around 12 minutes.

5 Conclusion

Quality aspects and importance

Quality elements that are important to terminal customers are reliability, flexibility, availability, time, costs, control, and after sales support. From past and current research it follows that especially reliability and costs (related to quality) are important quality dimensions for the overall quality. These quality elements can be applied to the services ship operations and yard operations at the container terminal. A further distinction of these services in sub-services is possible. Overall, it is important for the terminal operator to provide services that deliver excellent quality and fit into the value chain of its customers.

Qualityjudgement

Theory shows that structural measurement of quality is possible. In the quality judgement the terminal customers take centre stage. The important quality item reliability then refers to the degree to which the terminal operator delivers the service according to compliance with terms. This can be measured as a percentage form zero to 100 percent on a container-by-container basis. Quality of container terminal services can be measured. If measurement takes place, knowledge of the quality performance is the result. Probably, this knowledge about the

quality performance results in a need for improvement. This improvement of terminal quality may result in a better price for the services provided.

Quality and price

Genera1 evidence suggests a relation between the price quality ratio. This means that a higher quality may enable higher prices. This quality must first be defined and measured, before a higher price may be imposed. The terminal integrator first has to define service performance levels. The second step is a customer survey that leads to the third step; service performance improvement. A higher price for the container terminal service is only the last and final step in this process. In general, measuring quality of services must be carried out on a more or less regular basis in order to be able to signal changes in the judgement. At this moment, it is not possible to compare terminal service quality on this regular bases, as no data are available.

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